COMPATIBILISER EFFECTS ON PROPERTIES OF POLYAMIDE-6/ACRYLONITRILE-BUTADIENE-STYRENE AND POLYAMIDE-6/ACRYLONITRILE-BUTADIENE-STYRENE/SHORT GLASS FIBRE THERMOPLASTIC COMPOSITES

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A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy (Polymer Engineering)

Faculty of Chemical and Natural Resources Engineering
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JUNE 2010

'For my lovely wife Amaliah Othman, my kids – Afifah, Afif, Afwan and Afrina for supporting me – together we are going to achieve our dream'

ACKNOWLEDGEMENTS

I am grateful to my supervisor, Assoc. Prof. Dr. Abdul Razak Rahmat for his encouragement, guidance, criticism and academic freedom during the working in this project. The high standards set by him have not only greatly contributed to the quality of this work but also helped me become a better person.

I thank Prof Dr. Azman Hassan and the late Prof. Dr. Mohd Nasir Zainal Arif for skilfully co-supervising my PhD. This work would not have been possible without their research support and useful suggestions. I also thank Assoc. Prof. Dr. Mat Uzir Wahit for his support during my hard time and sharing happiness together. I also extend my appreciation to Pn Munirah Mokhtar for helping me to be my proof reader of my thesis.

I also wish to express my appreciation to the technical members of Polymer Engineering, especially Ms. Zainab Salleh, Mr. Suhee Tan and Mr. Nordin Ahmad, the Quality Control staffs at Poly-Star Compounds Sdn. Bhd. and Nuclear Malaysia, Bangi for their help and support in my research.

I wish to thank Mr. Shaiful Nizam Iskandar, Polyethylene (M) Sdn. Bhd. for helpful discussions and exchange of ideas regarding rheology of the polymer blends. Special thanks, all the staff of Technical Service Laboratory, Polyethylene (M) Sdn Bhd, Kertih, for giving me opportunity to use their capillary and dynamic rheology, without them, my rheological study could not be materialised.

I would like to acknowledge Ministry of Higher Education (MOHE) grant 78142 and UTM Initial Research Student (IRGS) Grant 75223 throughout my studies.

I would also like to extend my gratitude to my family, especially mom-in-law for their inspiration and continuing support. Most of all, I thank my wife Amaliah Othman and my children, Afifah, Afif, Afwan and Afrina who have been a source of strength and motivation for success. I hope that by now they have forgiven me for all the weekends and long hours spent away in the laboratory.

ABSTRACT

Polyamide-6 (PA6), acrylonitrile-butadiene-styrene (ABS) and their blends are an important class of engineering thermoplastics that are widely used in electronic and automotive industries. Many efforts have been taken to improve the properties of both pure components and the blends. It was for this reason that the dynamic mechanical and rheological properties of PA6/ABS blend systems compatibilised by acrylonitrile-butadiene-styrene–maleic anhydride (ABS-g-MAH) was studied. The compatibiliser levels were kept up to 5wt. % in the blends. Short glass fibre (SGF) was used to improve the stiffness of the compatibilised blends and the fibre contents were from 10 to 30 wt. %. Therefore, the reason behind blending the PA6/ABS blends with short glass fibre was to balance the toughness and stiffness. Both the blends and corresponding composites were compounded using a counter-rotating twin screw extruder. Tensile, flexural and impact properties were determined using the injection moulded test samples according to ASTM standards. The mechanical properties of the blends and the composites were investigated in both static and dynamic modes. Rheological properties were investigated using rotational and capillary rheometer. In general, the mechanical strength either dynamic (refer to dynamic mechanical properties) or static conditions improved by incorporation of compatibiliser to the PA6/ABS blends. The incorporation of SGF into the PA6/ABS blends enhanced the mechanical strength but reduced the toughness of the composites. The rheological measurements confirmed the interaction between the blend components with the incorporation of compatibiliser has been improved. However, the compatibiliser has no favourable effect on the mechanical properties of the composites although it has significant effect on the blends of PA6/ABS. The compatibiliser increased the melt viscosity of the blends. The SGF increased the rheological properties especially viscosity and flowability of the composites. The optimum ratio of compatibiliser and SGF concentration were determined using power law, *n* and consistency index, *K* analyses. From the analysis, the optimum ratio obtained was 1.5 wt. % for 50/50 and 60/40 PA6/ABS blends and 3 wt. % for 70/30 PA6/ABS blends. The *n* values drastically decreased, when concentration of the SGF was about 20 wt % indicating more pseudoplastic nature for the composites and suggesting that, 20 wt % is the optimum SGF concentration.

ABSTRAK

Poliamida-6 (PA6), akrilonitril-butadiena-sterina dan adunannya merupakan satu bahan kejuruteraan termoplastik yang penting dan sangat luas penggunaanya dalam industri elektronik dan automotif. Pelbagai usaha telah diambil untuk memperbaiki sifat-sifat kedua-dua komponen dan adunannya, Ini menjadikan alasan kajian bagi sifat-sifat dinamik mekanikal dan reologi adunan PA6/ABS yang telah diserasikan oleh akrilonitril-butadiena-sterina-melaik anhadrida (ABS-g-MAH). Kandungan penserasi dalam adunan PA6/ABS telah ditetapkan sehingga 5 wt. %. Gentian kaca pendek (SGF) yang digunakan untuk mempebaiki kekakuan adunan yang diserasikan dan kandungannya diubah dari 10 hingga 30 wt. %. Oleh yang demikian, alasan disebalik campuran adunan PA6/ABS dengan gentian kekaca pendek adalah untuk mengimbangi sifat-sifat kekakuan dan kekukuhan adunan. Kedua adunan dan komposit diadun menggunakan penyemperit skru berkembar arah berlawanan. Sifat-sifat mekaniknya telah dikaji dalam keadaan mod static dan dinamik berdasarkan piawaian ASTM. Analisis dinamik mekanikal (DMA) telah dilakukan untuk mengkaji kelakukan dinamik mekanikal adunan dan komposit. Sifat-sifat reologi telah dikaji menggunakan alatan reologi rerambut dan pengayun. Secara umumnya, kekuatan mekanikal telah dipertingkatkan dengan penambahan penserasi ke dalam adunan PA6/ABS. Penambahan SGF ke dalam adunan juga telah mempetingkatkan kekuatan mekanikal bahan, tetapi menurunkan kekukuhan kompositnya. Keputusan reologi menunjukkan peningkatkan interaksi antara komponen adunan dengan penambahan SGF. Penserasi tidak mempunyai kesan terhadap sifat-sifat mekanik komposit, tetapi ada kesan yang ketara terhadap adunan PA6/ABS. Penserasi meningkatkan kelikatan leburan adunan. SGF pula meningkatkan sifat-sifat reologi komposit terutamanya kelikatan dan keboleh-alirannya. Nisbah kandungan penserasi dan SGF yang optimum telah ditentukan dengan menggunakan analisis indek hukum kuasa, *n* dan ketetapan, *K*. Dari analisis tersebut, kandungan optimum telah didapati adalah 1.5 wt % untuk adunan PA6/ABS 50/50 dan 60/40 PA6 dan 3 wt % pulak untuk adunan PA6/ABS 70/30. Penambahan SGF sebanyak 20 wt %, nilai indek hukum kuasa menurun secara mendadak menunjukkan komposit mempunyai sifat-sifat pseudoplastik yang jelas dan disimpulkan bahawa 20 wt % adalah kepekatan optimum bagi komposit PA6/ABS 60/40.